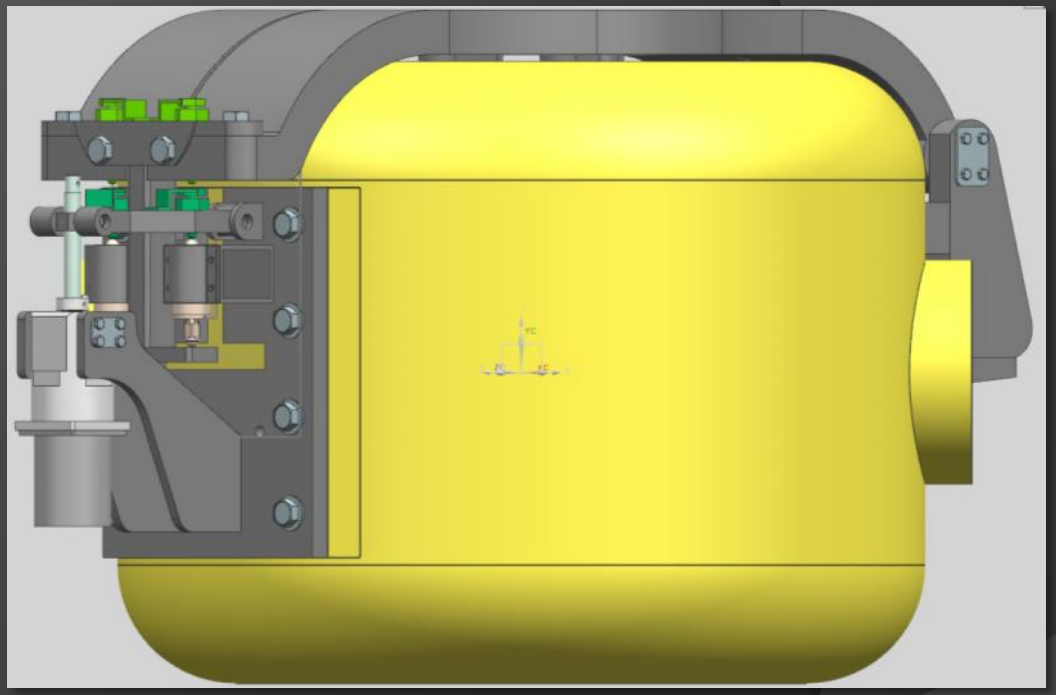
SSR1 Tuner concept

- Tuner requirements
- Tuner layout
  Critical features
- Helium Vessel concept



Tuner requirements

Cavity stiffness $= 25\ kN/mm$

Cavity elongation sensitivity $= 540\ \ kHz/mm$

Cavity force tuning $= 46\ N/kHz$

Range of the fast/fine tuning $\geq 1\ kHz\ (2\ \mu m)$

Range slow/coarse tuning $\geq 270\ kHz\ \ (500\mu m)$

Piezos cold (20K) stroke $= 10\ \mu m\ \ (efficiency\ \geq 20\%)$

Motor stroke $= 5\ mm\ (efficiency \geq 10\%)$

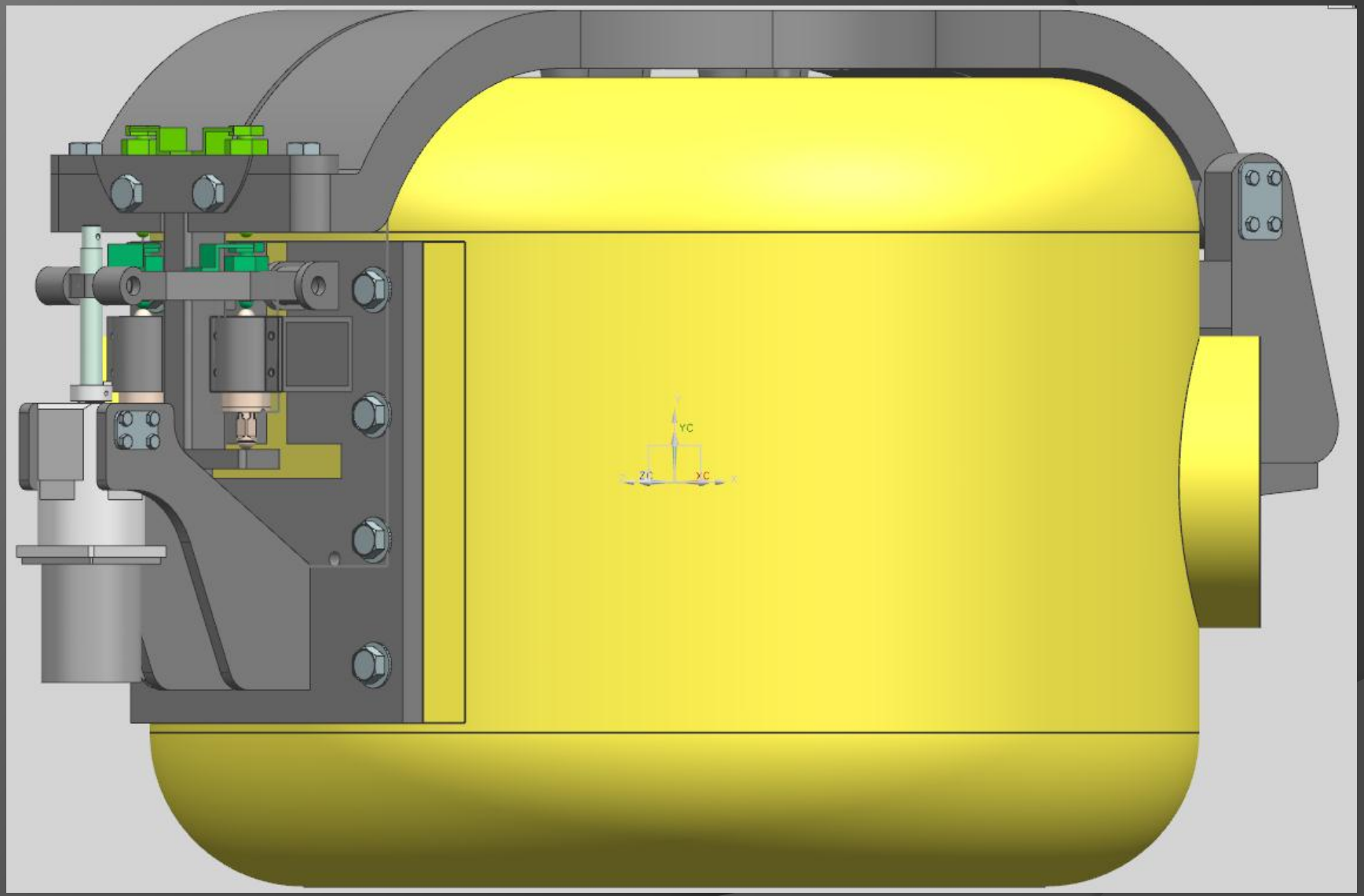
Stepper motor resolution $\leq 200\ Hz\ (1/5\ piezo\ stroke)$

Motor should not rotate under maximum load without holding current

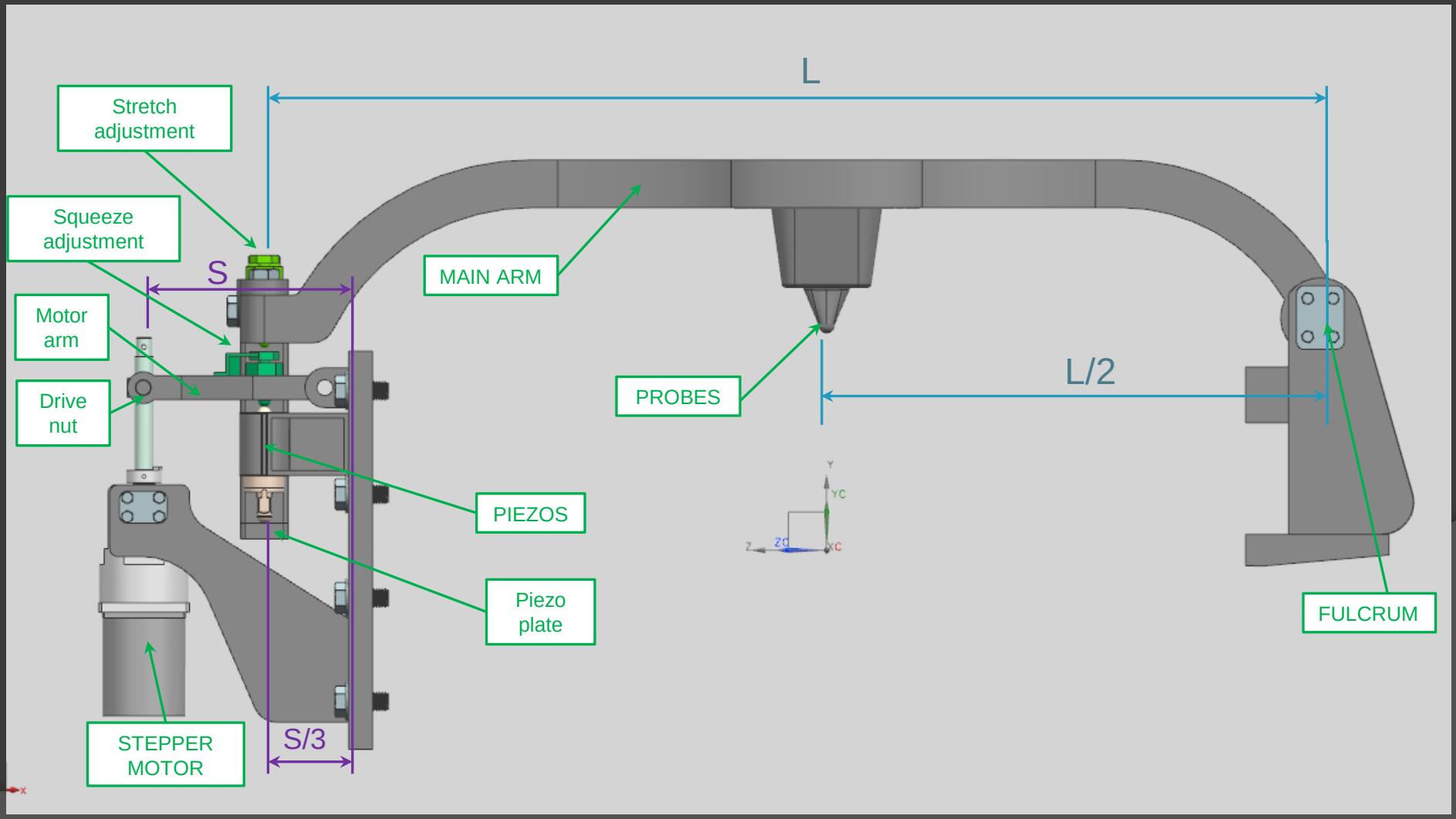
Bilateral operation (pulling during pressure tests)

One-handed operations through access port:

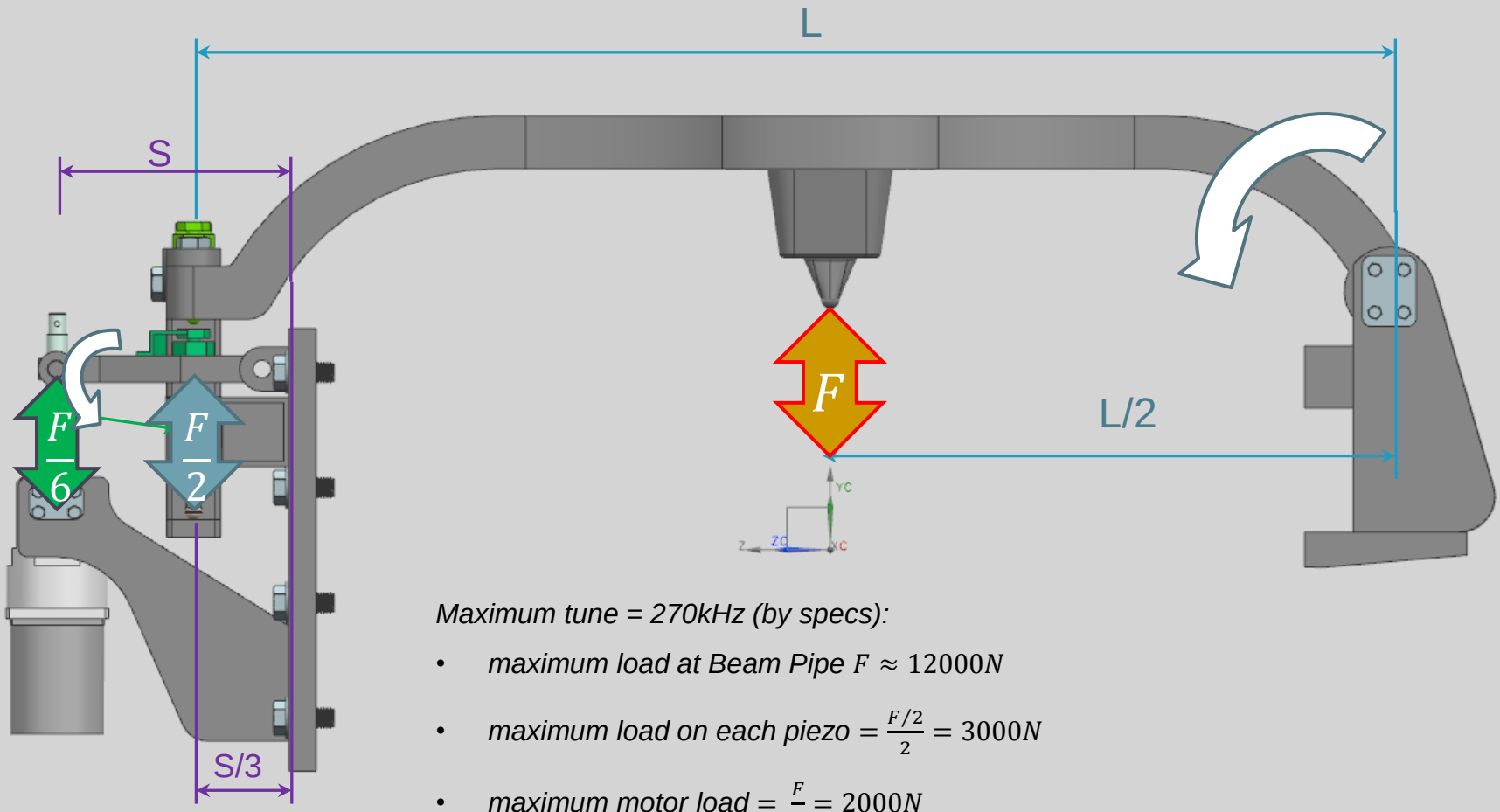
- *Removal of entire cartridge (motor + 2 piezos)*
- *Fine adjustment of the piezos (for pre-loading or release tuner tension)*


YC
ZC
XC

Main components



Load scheme



Maximum tune = 270kHz (by specs):

- *maximum load at Beam Pipe* $F \approx 12000N$
- *maximum load on each piezo* $= \frac{F/2}{2} = 3000N$
- *maximum motor load* $= \frac{F}{6} = 2000N$

Critical features

Piezos plate centering during operation – rotation and flex – reduce vs. favor

Shearing forces on piezos – mitigated by piezo housing – what is the limit?

Design of piezo housing – improve to protect piezo edges

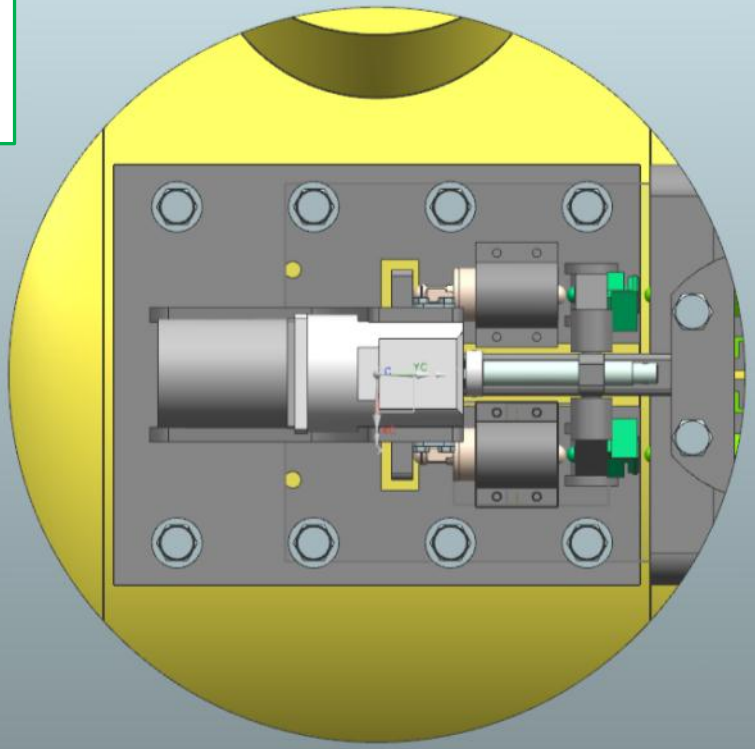
Backlash – reduce moving joints to a minimum and favor journal bearings?

Fine adjustments – differential screw details

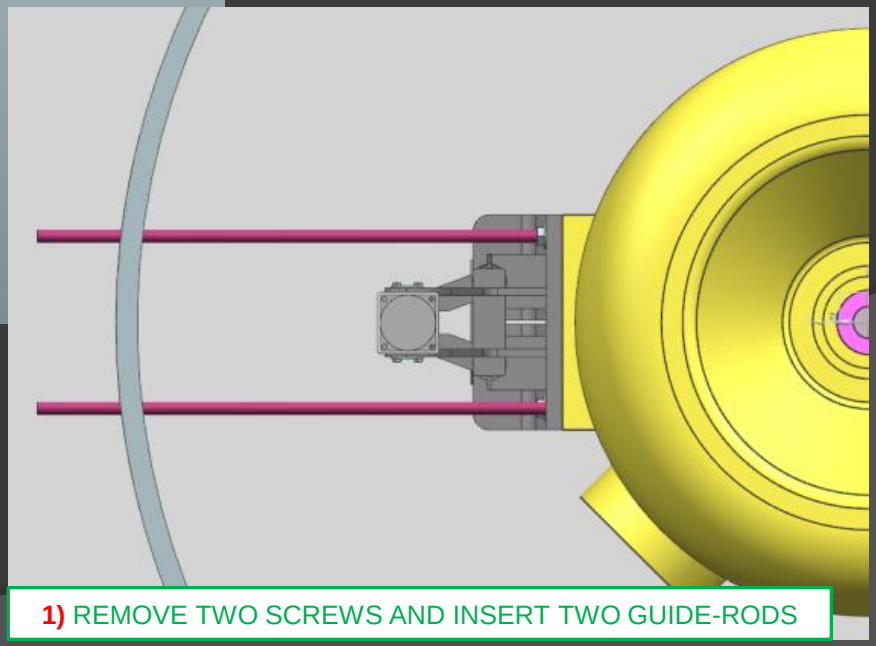
Alignment of all elements despite variations of helium vessels (~1-2 mm expected)

Removal of tuner cartridge

300mm of diameter so one arm can work inside

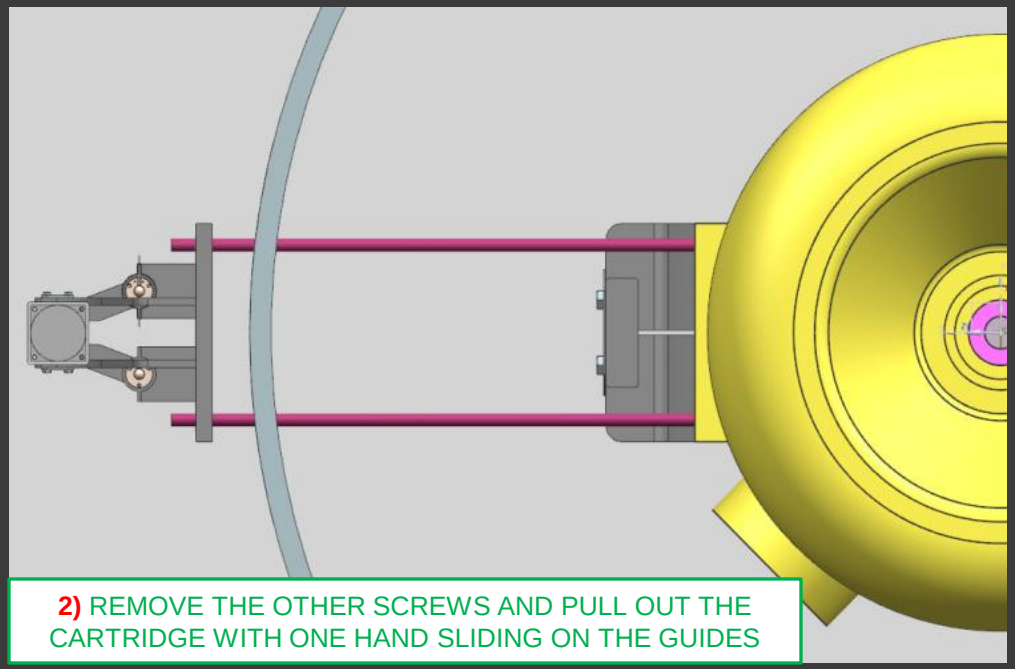


VIEW BY THE ACCESS PORT ON THE CRYOMODULE

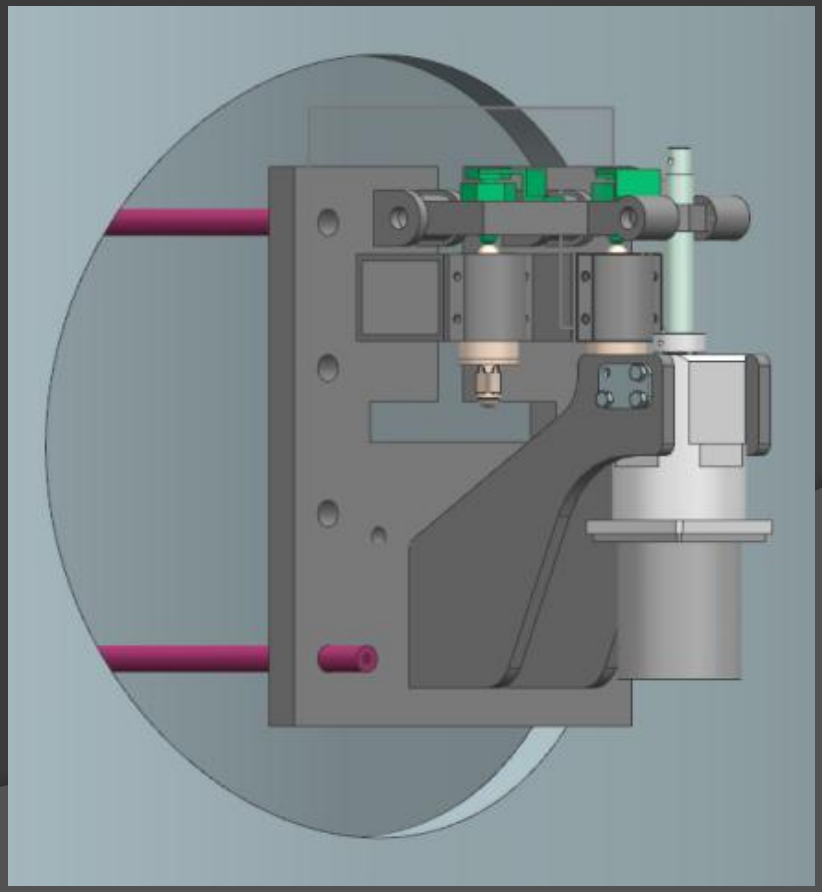


1) REMOVE TWO SCREWS AND INSERT TWO GUIDE-RODS

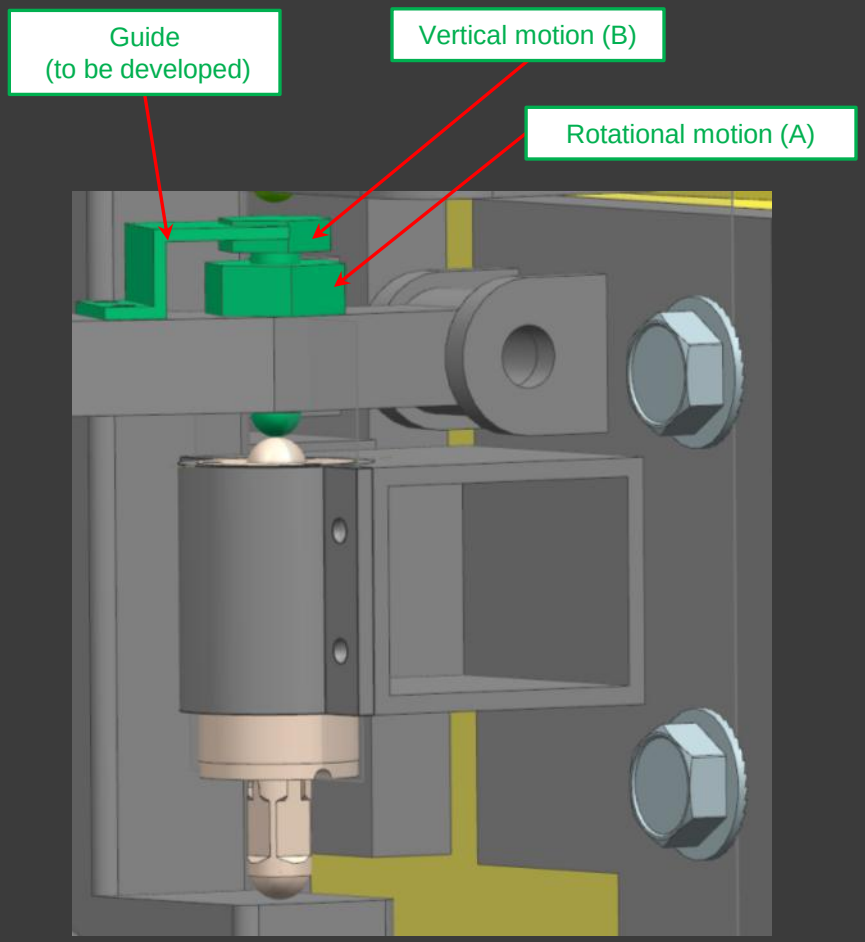
Removal of tuner cartridge



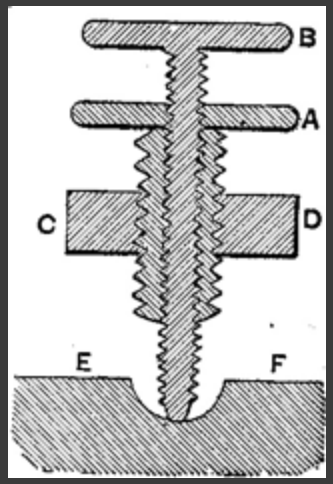
2) REMOVE THE OTHER SCREWS AND PULL OUT THE CARTRIDGE WITH ONE HAND SLIDING ON THE GUIDES



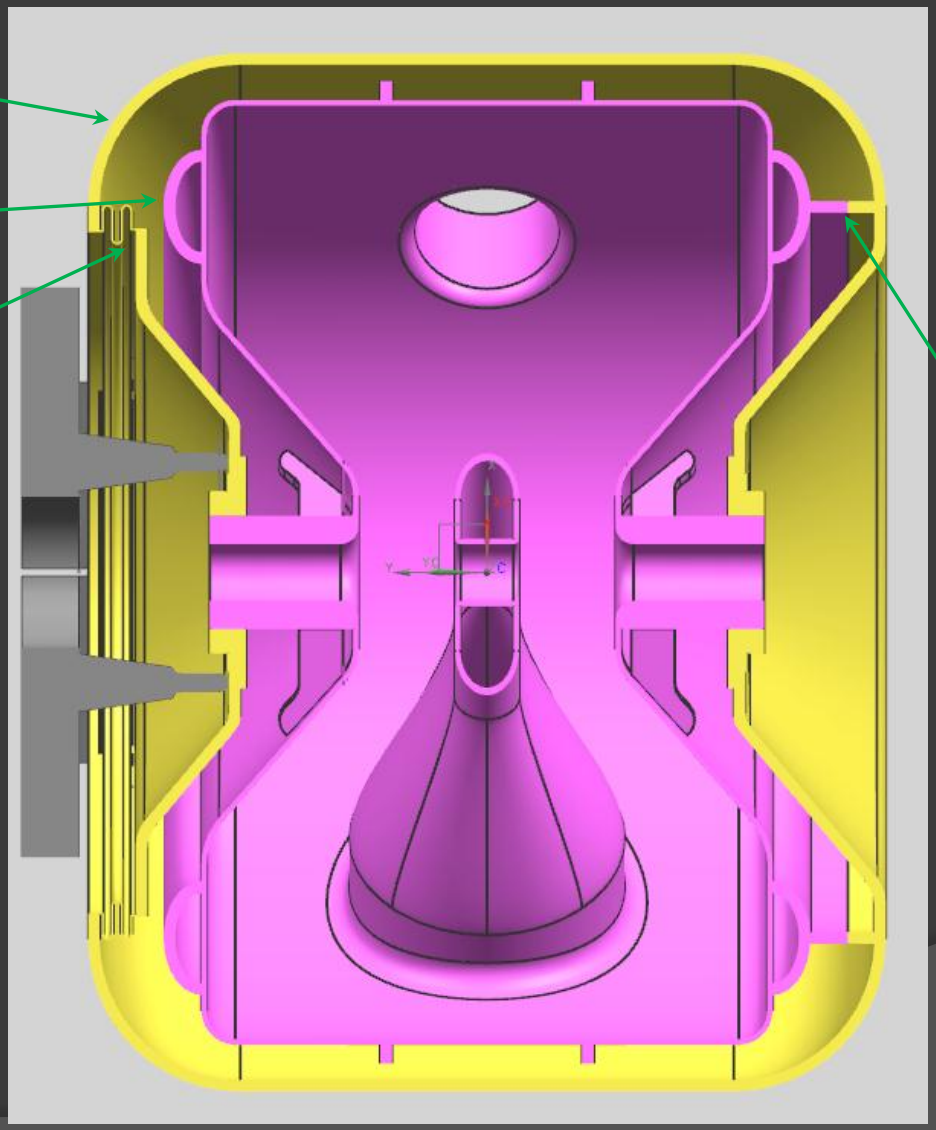
Fine adjustment of the piezos



Fine adjustment of the piezos with differential screw.
One-hand operation on (A) should allow fine adjustment



Helium Vessel concept



$k_{CAV} = 25\ kN/mm$

$\frac{df}{dl} = 540\ \ kHz/mm$

$\frac{df}{dp} \approx 0\ \pm 10\ \ Hz/torr$

Cu-brazed joint developed at ANL

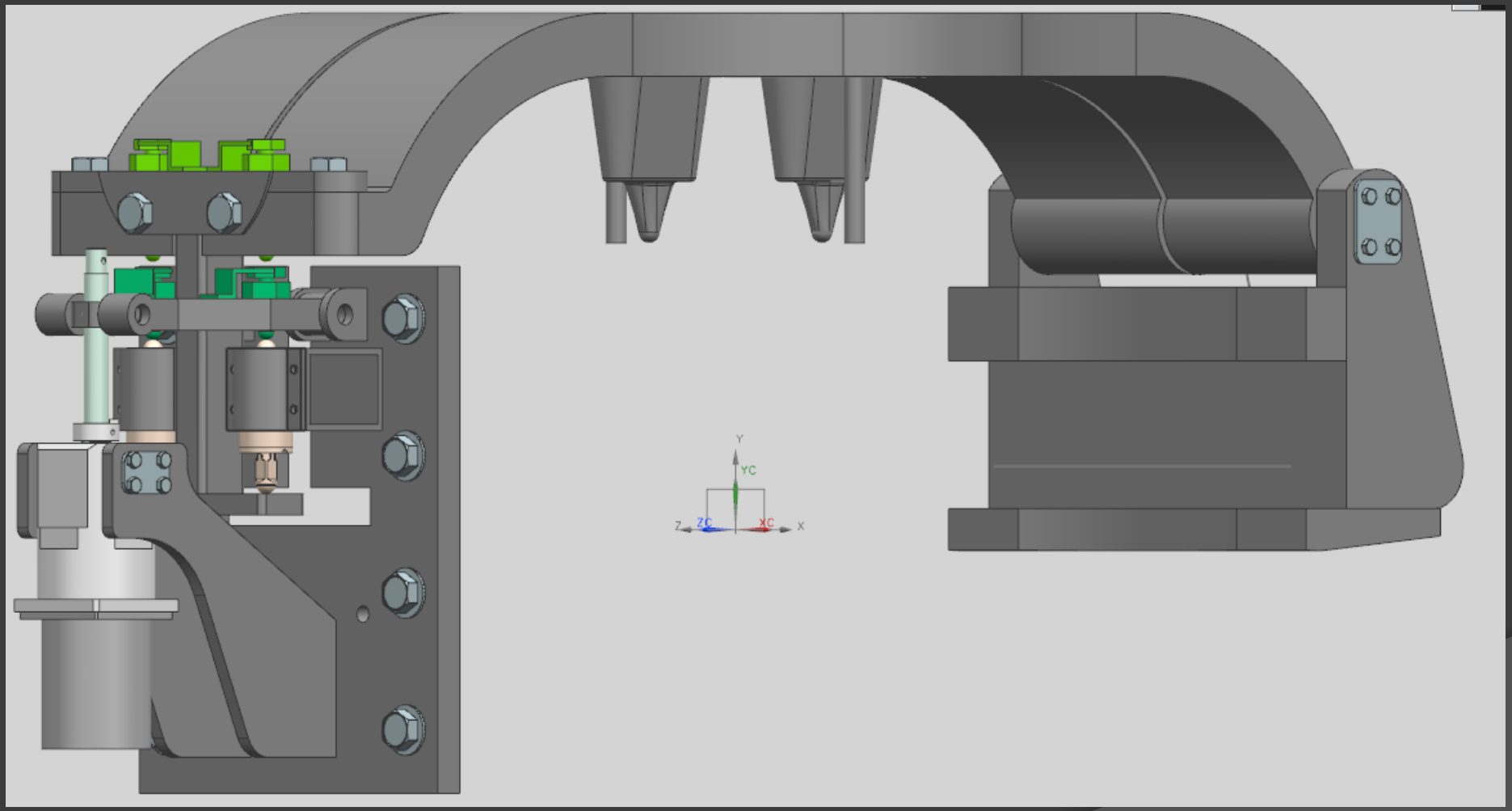
Next steps

Elastic FEM analyses to verify compliance with requirements (aforementioned + material allowables)

Study of dynamics and tribology

Feasibility and risk analysis

Selection of commercial components and hardware


Y
YC
Z
ZC
XC
X